15. (a) A flat belt, 8 mm thick and 100 mm wide transmits power between two pulleys, running at 1600 m/min. The mass of the belt is 0.9 kg/m length. The angle of lap in the smaller pulley is 165° and the coefficient of friction between the belt and pulley is 0.3. If the maximum permissible stress in the belt is 2 MN/m², Find :

(i) Maximum power transmitted ; and (7)

(ii) Initial tension in the belt. (6)

Or

(b) The spindle of a screw jack has single start square threads with an outside diameter of 45 mm and a pitch of 10 mm. The spindle moves in a fixed nut. The load is carried on a swivel head but is not free to rotate. The bearing surface of the swivel head has a mean diameter of 60 mm. The coefficient of friction between the nut and screw is 0.12 and that between the swivel head and the spindle is 0.10. Calculate the load which can be raised by efforts of 100 N each applied at the end of two levers each of effective length of 350 mm. Also determine the velocity ratio and the efficiency of the lifting arrangement.

PART C — (1 × 15 = 15 marks)

16. (a) A compressor, requiring 90 KW to operate at 250 rpm. The drive is by V-belts from an electric motor running at 750 rpm. The diameter of the pulley on the compressor shaft must not be greater than 1 meter while the center distance between the pulleys is limited to 1.75 m. The belt speed should not exceed 1600 m/min. Determine the number of V belts required to transmit the power if each belt has a cross sectional area of 375 mm², density 1000 kg/m³ and an allowable tensile stress of 2.5 Mpa. The groove angle of the pulley is 35°. The coefficient of friction between the belt and the pulley is 0.25. Also calculate the length of each belt. (15)

Or

(b) (i) Derive an expression for minimum number of teeth on the wheel in order to avoid interference. (8)

(ii) In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 240mm and the length of the driving crank is 120 mm. Determine the inclination of the slotted bar with the vertical in the extreme position and the time ratio. If the length of the slotted bar is 450mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever. (7)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 53303

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY, 2019.

Third/Fourth Semester

Mechanical Engineering

ME 6401 — KINEMATICS OF MACHINERY

(Common to Mechanical Engineering (Sandwich), Mechatronics Engineering)

(Regulation 2013)

(Also common to PTME 6401 — Kinematics of Machinery for B.E. Part-Time for Third Semester — Mechanical Engineering — Regulation 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate rigid and flexible links.

2. Define Transmission angle of a four-bar mechanism. What are the maximum and minimum values of transmission angle? Sketch them.

3. What is a relative pole, with respect to velocity analysis?

4. What are the different methods used for finding the velocity?

5. Which type of cam follower motion is preferred for high speed engines? Why?

6. Give any two applications of cam mechanism in IC engines.

7. What do you understand by the term 'interference' as applied to gears?

8. What are the special advantages of epicyclic gear trains?

9. Write the mathematical expression for the maximum efficiency of a screw jack.

10. Write mathematical expression for the length of the belt required for two pulleys of diameters d_1 and d_2 and at distance x apart are connected by means of an open belt drive.

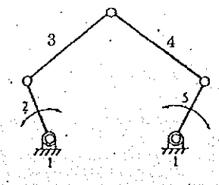
PART B — (5 × 13 = 65 marks)

11. (a) What is a kinematic inversion? Discuss any three applications of inversions of slider crank mechanism with suitable sketches.

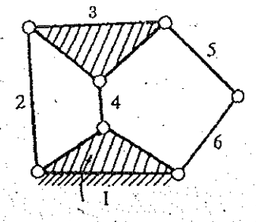
Or

(b) (i) Find the degrees of freedom for the mechanism shown in Fig.Q.11(b)(i).

(1)



(2)



(3)

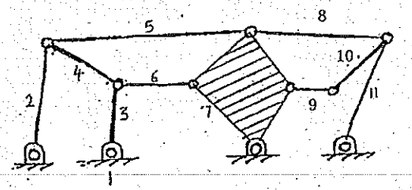


Fig.Q.11(b)(i)

(ii) Explain mechanical advantage and transmission angle related to four bar mechanism.

12. (a) In a four bar chain ABCD, AD is fixed and is 15 cm long. The crank AB is 4 cm long and rotates at 120 rpm clockwise, while the link CD (whose length is 8 cm) oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60°.

Or

(b) The crank of a slider crank mechanism is 15 cm and the connecting rod is 60 cm long. The crank makes 300 rpm in the clockwise direction. When it has turned 45° from the inner dead centre position, determine (i) acceleration of the mid-point of the connecting rod and (ii) angular acceleration of the connecting rod.

13. (a) (i) Draw the displacement, velocity and acceleration curves, when the follower moves with simple harmonic motion and derive the expression to maximum velocity and maximum acceleration.

(ii) Depict the types of cams.

Or

(b) Follower type = roller follower, lift 25 mm; base circle radius = 20 mm; roller radius = 5 mm; out stroke with UARM, for 120° cam rotation; dwell for 60° cam rotation; return stroke with UARM, for 90° cam rotation; dwell for the remaining period. Determine max. velocity and acceleration during out stroke and return stroke if the cam rotates at 1200 rpm in counter clockwise direction.

Draw the cam profile for conditions with follower off set to right of cam center by 5 mm.

14. (a) (i) Prove that the max length of arc of contact between a pair of gear tooth to avoid interference is $(r+R)\tan\phi$. (5)

(ii) Two mating gears have 20 and 40 involute teeth of module 10 mm and 20° pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine the addendum height for each gear wheel, length of the path of contact. (8)

Or

(b) A compound epicyclic gear is shown in Fig. Q.14(b). The gears A, D and E are free to rotate on axis P. The compound gear B & C rotate together on the axis Q at the end of arm F. All gears have equal pitch. The number of external teeth on gears A, B and C are 18, 45 and 21 respectively. The gears D & E are annular gears. The gear A rotates at 100 rpm in anticlockwise direction and gear D rotates at 450 rpm clockwise. Find the speed and direction of the arm F and the gear E. (13)

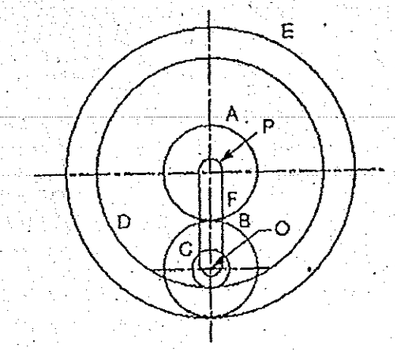


Fig. Q.14(b)